THE GREAT SOLID FUEL DEBATE

Exploring the drivers and barriers of pro-environmental behaviour: domestic solid fuel combustion in Hampshire, UK.

SUMMARY

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Introduction

This study set out to explore the drivers, perceptions and barriers related to the use of domestic solid fuel burning (DSFB). For example, the burning of coal or wood in a stove within the home.

This report is the first to concentrate on DSFB within the UK, in relation to a person's values and their behaviours, to identify the underlying motivations and the barriers to changing their behaviour. With domestic wood burning being the single largest contributor to outdoor air pollution during UK wintertime, this research is significant as it addresses the knowledge gap as to why DSFB has increased in popularity and which variables drive or limit bad practice.

Background

Globally, the World Health Organisation estimated in 2018 that 3.8 million people die prematurely from household air pollution every year, with Public Health England in 2019 estimating that 36,000 people in the UK die annually. Exposure to air pollution can be detrimental to health as it causes noncommunicable diseases including stroke, heart disease and lung cancer, as well as negative effects on the environment and economic growth. Therefore, air pollution sources must be identified, understood and characterised to implement effective control strategies and validate environmental policy.

DSFB has become a concern to the scientific and policy communities. In the Global North, it was previously thought that the dominant source of outdoor air pollution was traffic. However, the National Atmospheric Emissions Inventory (NAEI) announced in 2016 that particulate matter (PM) from UK wintertime domestic wood burning (DWB), a type of DSFB, has been systematically underestimated by a factor of three. Furthermore, Defra stated in 2018 that DWB is now the single largest contributor to outdoor air pollution during UK wintertime, making up 38% of ambient outdoor PM. Research has predicted that this increase is due to the Stove Industry Alliance's (SIA) marketing labelling DWB as carbon neutral. Although DWB can have this characteristic, it is hard to achieve if best practice is not followed. For example, under adverse weather conditions, Particulate Matter from DWB in quiet residential neighbourhoods from family houses can be as harmful as heavy traffic in central urban areas. While it was previously thought that buildings shield and safeguard inhabitants from outdoor air pollution, two thirds of studies have found that indoor sources (e.g. DSFB) can be more harmful than outdoor sources due to infiltration and lack of ventilation inside the home. The lack of data defining the magnitude of DSFB as an air pollution source has caused academics' significant concern.

Figure 1 below from Defra shows that although a Defra-exempt stove is significantly cleaner, it is still hundreds of times "more dirty" than a domestic gas boiler.

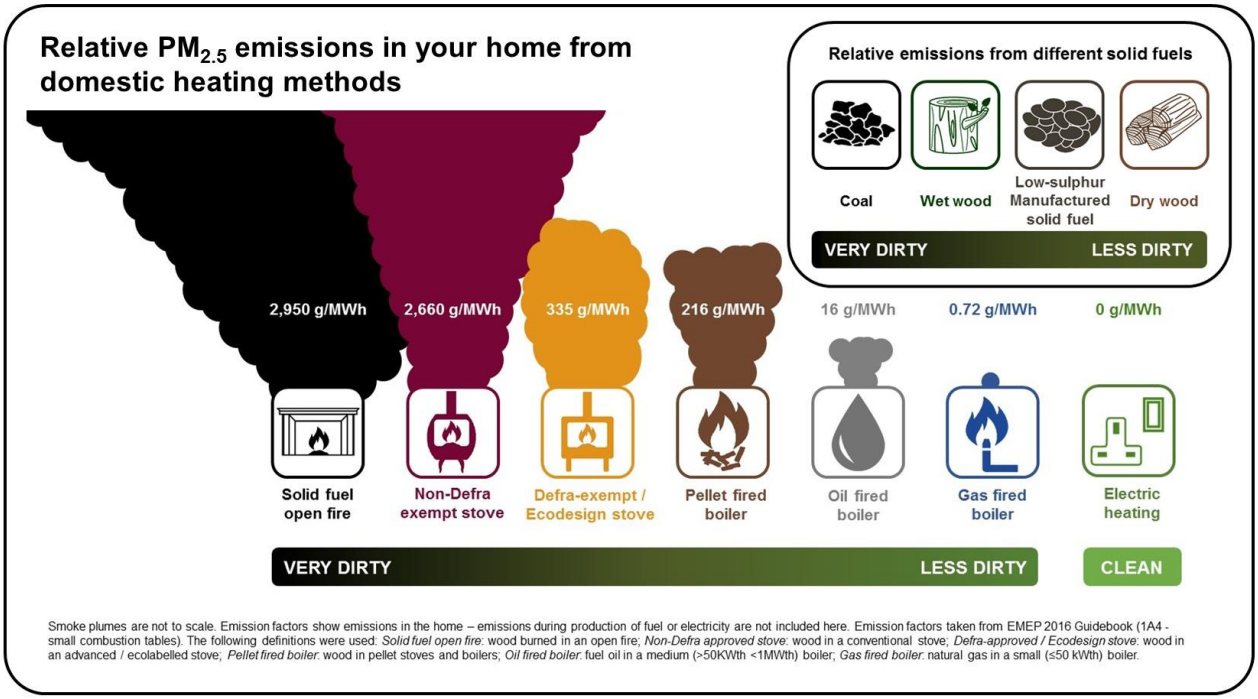

Figure 1 - Relative $PM_{2.5}$ emissions in your home from domestic heating methods (Source: Defra).

Scope of the Study

The town of Alton in Hampshire was used to narrow the scope of the study and reduce the effect of different geographical variables enabling an in-depth analysis of the demographic, internal and external factors for burners and non-burners (definitions in Table 1 below).

Table 1 - PEB factors' definitions.

Factor	Definition
Demographic:	Age, gender, ethnic background, living situation, tenure, highest education level and employment.
Internal:	Individual, dispositional characteristics that influence a person's behaviours and actions.
External:	Collective and systemic contextual factors which are made up of the individual's physical environment.

Quantitative measurements were made using outdoor air quality sensor in Alton showing air pollution levels in January 2021. The $PM_{2.5}$'s spikes in Figure 2 below may be from DSFB due to cold weather (snow) and diurnal patterns (evenings and weekends) when people spend most of their time at home. This indicates that DSFB is likely to contribute significantly to ambient air pollution, demonstrating that Alton is an appropriate case study.

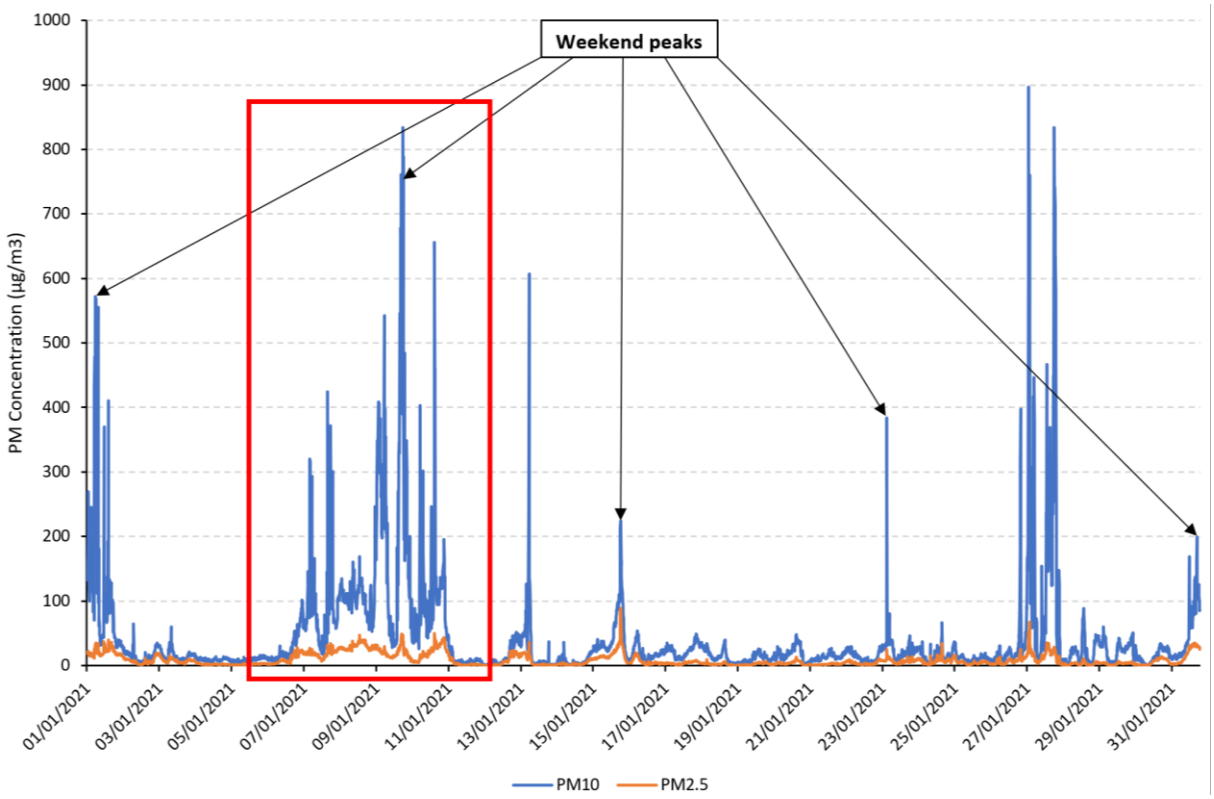

Figure 2 - PM concentrations (µgm^{-3}) measured by outdoor sensor #51438 in Alton, Hampshire in January 2021. Red box = during snowy weather (Source: Author).

Study Results

A number of datasets were used from different sources, enabling a thorough investigation of these complex behaviours and identifying findings to suggest further research and contribute to future policy.

The research investigated to what extent demographic factors play a part in affecting DSFB practices. My research found that age was Alton's main DSFB driver, with 50–59-year-olds being the most common burner age. Living arrangements, tenure and employment status were also identified as possible contributors. Therefore, future interventions will need flexible approaches to suit local context and generational differences.

When exploring internal factors, burners' selective motives were unveiled, seeming to hold important power in driving DSFB practices. Homeliness, comfort and warmth were given the most value - overriding environmental concerns. These selective motives created strong emotional ties between the burner and practice, with women showing a significantly stronger nostalgic relationship than men. Alternatively, the environment was found to drive non-burners to not DSFB.

However, some burners began DSFB because it was previously falsely branded as carbon neutral but continued the practice even though they were aware of and concerned for the environmental impact, causing discomfort from the two conflicting beliefs. This shows that burners may have deeper intrinsic values to protect the environment. This research is significant as it shows that governments must smooth out this misconception and connect burners with the correct

environmental information, targeting burner's intrinsic motivations concerning environmental protection. Consequently, this may reduce or stop burners to DSFB because the environment may become their highest priority again.

Two non-burners recounted their first-hand experiences of DSFB's effects, demonstrating higher education's value, compared to burners who could not. This result shows how first-hand experiences can generate closer psychological distance to the practice's impacts by visibly and tangibly showing how DSFB can negatively affect people's health and the environment. Furthermore, my research shed light on how an individual's previous education and career can fundamentally alter their future DSFB behaviours. Even though everyone will not experience the effects of DSFB first-hand, using these individuals as to inform and educate people could influence DSFB behaviours in the future.

Finally, burners responded positively to external factors, such as annual appliance checks and introducing environmentally friendly yet more expensive DSFB fuels. This illuminates the fact that, even though burners have indicated they want to continue to DSFB, they would change their behaviours to effectively reduce their environmental impact. Therefore, external factors were highlighted to extensively influence DSFB practices. These findings could be useful for future policymakers, suggesting the future policies mentioned in my survey (e.g. annual appliance checks, introducing environmentally-friendly fuels) should be implemented in Alton and the wider UK.

Conclusion

To conclude, this study presents several opportunities for future research to build on these findings. Researchers could adopt this methodology and apply it to other towns across the UK, investigating whether there are similarities or disparities between the results. Furthermore, a follow-up study could investigate whether respondents' DSFB behaviours have changed after reflecting on Pro-Environmental Behaviour (PEB) within this study. Finally, future research needs to approach sampling differently by making sure that participants are not engaged with PEB. This will find out their most influential causal relationships between the demographic/situational, internal and external factors. Arguably, this sub-group could have a larger gap between their values and their behaviours compared to the scope of the study, demonstrating this fruitful area of further work.